optically flat mirrors of such size and so great perfection was a very great achievement."

RADIANT POINTS OF JULY AND AUGUST METEORS.—A paper by Mr. Denning in No. 3874 of the *Astronomische Nachrichten* describes the meteor showers which occur about the same time of the year as the splendid Perseid shower, and it gives, in tabular form, the radiant points of more than one hundred showers that have been observed at Bristol, during 1876–1902, in the months of July and August, dividing the epochs of appearance into three periods, viz. July 6–16, July 20–August 16, and August 19–25. Many of the displays are feeble, and a prominent feature of these is that they appear for a long period from the same fixed radiant.

The Perseid swarm varies greatly in intensity; at some apparitions as many as 150 to 200 shooting stars are observed per hour, whereas at other appearances the hourly rate may decline to 20 or 30. From a careful survey of the records, Mr. Denning thinks that there is evidence of this shower having a periodicity of between 104 and 123 years. The maximum is now reached on the morning of August 12 or 13.

SUN-SPOTS AND TERRESTRIAL TEMPERATURE.—In discussing the statement recently made by M. C. Nordmann in its application to the temperatures observed at the Jacob camp (Guadeloupe), M. Alfred Angot finds that approximately the same law holds good, and may be represented by the formula

$$t = t_0 + ar,$$

where t is the actual temperature, r is Wolf's frequency number, and t_0 and a are constants for each station, a being a negative quantity. On calculating the temperatures for the Jacob station from this formula, first determining the constants for that place, it is found that they vary but slightly from the observed values, the mean variation being $\pm 0°{\cdot}06$ C., and M. Angot suggests that an analysis of the annual variations at a number of stations might reveal the presence of further periodical variations (*Comptes rendus*, No. 21).

THE SATELLITES OF SATURN.—*Bulletin* No. 34 of the Lick Observatory contains the results of a second series of observations of the satellites of Saturn made by Mr. W. J. Hussey of that observatory.

Mr. Hussey measured the position angles and distances of each satellite in respect to one of the others, and gives a table containing all the details of each observation; he concludes from estimations of their respective light values that Mimas is probably larger than Hyperion, and, from his measurements, that the generally accepted diameter of Titan is undoubtedly too large; 2500 miles is, according to him, a much nearer approximation to the true value than the values given in most text-books.

THE ROYAL SOCIETY CONVERSAZIONE.

MANY of the objects on view at the Royal Society conversazione on Friday last were shown at the gentlemen's conversazione held on May 15, and have already been described in these columns (p. 59). There was, however, a number of additional exhibits illustrating methods and results of recent work in many branches of science, and these are mentioned below.

The condensation of the radio-active emanations of radium and thorium by liquid air formed the subject of an exhibit by Prof. E. Rutherford, F.R.S., and Mr. F. Soddy. The radio-active emanations of thorium and radium appear to be the residues of the thorium atom and radium atom respectively after the heavy positively charged particles, known as the "α rays," have been projected. They have all the properties of inert gases of the argon family, and diffuse away from the radium and thorium compounds producing them. They can be condensed at the temperature of liquid air, and are again volatilised on raising the temperature. Their actual quantity is almost infinitesimally small, being quite invisible and unweighable, but their presence can be detected by their property of radio-activity.

A method for the rapid determination of the specific gravity of blood, taken from a single drop, was shown by Prof. W. J. Sollas, F.R.S. A fluid heavier than the blood (chloroform and benzole sp. gr. 1·07), and another lighter (benzole and chloroform sp. gr. 1·04), are introduced into a tube, the heavier first, so that the lighter, added subsequently, floats upon it. The two fluids mix by diffusion so as to produce a column in which the specific gravity varies continuously from a higher to a lower value upwards. A drop of blood obtained from a pin prick is then added, and sinks in the column until it reaches a level where the specific gravity is identical with its own. Two glass floats of known specific gravity are now introduced, one of higher and the other of lower specific gravity than the blood. The distances of these, when floating in the column, from the drop of blood are proportional to the difference in specific gravity.

Mr. J. Y. Buchanan, F.R.S., exhibited a copper sphere and brass tube in illustration of an effect produced by the momentary relief of great pressure. Experiments were made during the cruise of the *Challenger* and on board the *Princess Alice*. The copper sphere contained a glass spherical flask of about $1\frac{1}{2}$ inches in diameter hermetically sealed, and the sea water had free access through the two holes at the poles. The brass tube contained a glass tube of 50 cubic centimetres in capacity, hermetically sealed, and the sea water had free access at both ends of the brass tube. The brass tube was sent to a depth of 3000 metres, and at some, probably less, depth the internal glass tube gave way to the pressure and collapsed suddenly. The enclosing brass tube was pinched up by the external pressure. The experiment shows that, in the time, it was easier to pinch the envelope of brass than to shove in the plugs of water at both ends. The copper sphere was sent first to 3000 metres, but was pulled up without showing any effect. It was then sent to 6000 metres, and the internal glass flask collapsed at some depth between 3000 and 6000 metres, and the creasing which is visible on the copper sphere was produced. These experiments, whether made with the copper ball or with the brass tube, furnish striking demonstrations of the importance of the element of *time* in all physical considerations.

Photographs of the paths of aërial gliders were shown by Prof. G. H. Bryan, F.R.S., and Mr. W. E. Williams. These photographs were taken by attaching a piece of magnesium wire to gliders of cardboard, and show the path taken during their descent through the air. By fixing a rotating wheel in front of the camera so as to give a series of exposures instead of a continuous exposure, dotted traces were obtained, the distance between the dots enabling the velocity at different points to be compared.

The solar disc in monochromatic (K) light was exhibited by the Solar Physics Observatory, South Kensington. The glass positive and negative shown was a specimen of one of the trial plates taken for adjustment of the new photo-spectroheliograph. Large belts of prominences could be seen stretching across the solar disc.

The Solar Physics Observatory also exhibited photographs of the spectrum of lightning. The spectra were secured by Dr. William J. S. Lockyer on the early morning of May 31. Small cameras were employed fitted with Thorpe's transparent gratings in front of the lenses.

A reproduction of the hydraulic organ of the ancients was shown by Mr. John W. Warman. This instrument, originally invented by Archimedes about 250 B.C., has furnished a problem for at least 600 years, and has been the subject of endless speculation. The only real difference between the hydraulic and the ordinary or "pneumatic" organ is that, in the former, the wind-pressure is derived from the weight of an annular mass of water, instead of from the loaded top of a folded air-bellows.

Mr. W. N. Shaw, F.R.S., had on view the July number of the Monthly Pilot Charts of the North Atlantic and Mediterranean, issued by the Meteorological Council. The chart was exhibited to show the modifications introduced since the commencement of the series in April, 1901.

Bactericidal emanations from radium were demonstrated by Mr. Henry Crookes, who also showed photographs of a box of instruments, (*a*) taken by ordinary Röntgen rays, (*b*) taken by radium emanations at a distance of eighteen inches.

Other subjects of exhibits belonging to the physical sciences were :—photographs illustrative of the Coronation Naval Review, 1902, Dr. W. J. S. Lockyer; the Cooper-Hewitt mercury vapour lamp of the British Westinghouse Electric and Manufacturing Company, Ltd., by Prof. Ernest Wilson; an automatic mercury vacuum pump, by Dr. S. R. Milner; (1) stereoscopic fluoroscope, (2) stereoscopic X-ray photographs, Mr. J. Mackenzie Davidson; detonation of small shells, Dr. O. J. Silberrad; (1) apparatus for obtaining monochromatic illumination with the microscope, (2) a new turbidimeter, for determining the turbidity of water, by Mr. Charles Baker; controlling and regulating spark discharges, experiments in illustration, by Mr. Alfred Williams.

Prof. E. B. Poulton, F.R.S., illustrated the protective resemblance of butterflies to dead leaves and fragments of dead leaves. A resemblance to entire dead leaves with mid-rib, traces of oblique veining, and often attacked by fungi, is found in many genera of tropical butterflies. Holes, when represented, appeared to have been gnawed by insects, &c. There are three stages in the representation of such holes :—(1) by opaque strongly reflecting "body colour"; (2) by transparent windows; (3) by actual apertures. In the Holarctic region, with its deciduous trees, a genus (Polygonia = Grapta) which is defended by the same kind of concealment resembles, not entire leaves, but weather-beaten and ragged fragments, and it is not a gnawed hole which is represented on the butterfly, but a curved crack due to chemical and mechanical changes in a dead leaf fragment.

The director, Royal Botanic Gardens, Kew, showed three interesting instances of plant adaptations, namely, (1) a sensitive orchid (*Masdevallia muscosa*) from New Grenada. The lip closes when an insect lights on it; the insect, in crawling out, is compelled to carry the pollen masses away with it. (2) A case of commensalism (*Dischidia rafflesiana*) from Java. Leaves become converted into bags which ants fill with soil; the plant sends roots into the "flower pots" thus formed. (3) A possible case of protective mimicry (*Mesembryanthemum Bolusii*) from South Africa. The fleshy leaves simulate the lichen-covered fragments of rock amongst which they grow.

An exhibit by Dr. D. H. Scott, F.R.S., and Prof. F. W. Oliver illustrated Lyginodendron and its seed Lagenostoma. Lyginodendron is a characteristic member of the Palæozoic group Cycadofilices, a group recognised as occupying an intermediate position between ferns and gymnosperms. Hitherto no certain knowledge of the reproductive organs of these plants has been available. A reinvestigation of the detached Coal-measure seeds belonging to Williamson's genus Lagenostoma has furnished evidence which leads to the conclusion that one of them (*Lagenostoma Lomaxi*) was borne by Lyginodendron.

Fossil vertebrata from the Fayûm, Egypt, were exhibited by the director, British Museum (Natural History). The most important of the specimens were portions of the skull of the remarkable horned mammal, Arsinoïtherium, from the Upper Eocene. Specimens of the upper and lower dentition of the primitive elephants Palæomastodon and Mæritherium were also exhibited; these showed that the teeth are comparatively simple, and that the premolars and molars are in use simultaneously as in the ordinary mammal. Remains of the elephant and antelopes associated with flint implements from the lake beds of the lake Birket-el-Kerun were also shown.

A chart representing the first results of experiments on the migrations of plaice in the North Sea was shown by the Marine Biological Association. The distances travelled by some of the fishes have been very great, amounting in one case to 160 miles in six weeks. The Association also had on view a new British species of the Polychæte family Sabellaridæ, and living representatives of the Plymouth marine fauna.

The following were also among the objects on view :—mounted specimen of newly-born Indian elephant (*Elephas maximus*), born in the Zoological Society's Gardens, showing the hairy nature of the skin, as in the mammoth, by the director, British Museum (Natural History). A series of spear-heads, manufactured by the existing Aborigines of the north-west territories of Western Australia, by Dr. Henry Woodward, F.R.S. Remains of fossil mammals from an ossiferous cavern of Pliocene age at Doveholes, near Buxton, Derbyshire, by Prof. W. Boyd Dawkins, F.R.S. Colour photographs of living insects to illustrate protective coloration and resemblance, by Mr. F. Enock. (1) Tail feathers from a common male pheasant, illustrating sexual transformation of plumage; (2) a wild duck bred in captivity showing a converse change, by Mr. S. G. Shattock and Mr. C. G. Seligmann.

During the evening Prof. E. B. Poulton gave an account of the discoveries of Mr. Guy A. K. Marshall upon the wet season and dry season forms of Rhodesian butterflies. Mr. Marshall has proved, in three cases, by breeding the one from the other, that butterflies which are entirely different in colour, pattern, shape, relation of upper side to under side of wings, and even habits, and the selection of a certain type of country, are only the summer and winter forms of one species. The winter forms are always the better concealed in these cases, probably because the butterfly passes a much larger proportion of its life in a state of complete repose.

The Bioscope Company gave a lantern demonstration illustrating the scientific and educational applications of the bioscope.

THE ENGINEERING CONFERENCE.

LAST week the Institution of Civil Engineers held the bi-annual engineering conference for the present year, under the presidency of Mr. John Clarke Hawkshaw, president of the Institution.

The proceedings commenced on the evening of Tuesday, June 16, when Mr. W. H. Maw, past-president of the Institution of Mechanical Engineers, delivered the eleventh "James Forrest" lecture in the theatre of the Institution, his subject being "Some Unsolved Problems in Engineering." We published an abridgment of Mr. Maw's address last week (p. 163). On the following day, Wednesday, June 17, the chief business of the meeting commenced, and was continued over the Thursday and Friday following. The conference was divided into seven sections, the members of which met in various rooms near the Institution house in Great George Street. These sections were as follow :—Section i., railways, chairman, Sir Guilford Molesworth; section ii., harbours, docks and canals, chairman, Sir Leader Williams; section iii., machinery, chairman, Dr. Alex. B. W. Kennedy; section iv., mining and metallurgy, chairman, Mr. E. P. Martin; section v., shipbuilding, chairman, Sir John I. Thornycroft; section vi., waterworks, sewerage and gasworks, chairman, Sir Alexander Binnie; section vii., applications of electricity, chairman, Mr. Alexander Siemens.

Before proceeding to the various section rooms, members of the congress assembled in the theatre of the Institution of Mechanical Engineers to hear an introductory address from the president of the Institution of Civil Engineers, Mr. J. C. Hawkshaw. The address alluded to the work done at past conferences, and subsequently referred to the Engineering Standards Committee, which had been organised by the Institution in conjunction with various other technical bodies. The subject of the education and training of engineers was also touched upon, and in connection with the Admiralty scheme of training, the president pointed out that a similar plan of operations was devised by the Institution for the admission of students and associate members. Referring to the pollution of the town by smoke, the president said that "neglect to deal with it is yearly costing the growing population of London a large sum, and a Royal Commission had been appointed to inquire into the subject." The problems of locomotion and transport, timber supplies, and motor-car traffic were also dwelt upon briefly.

RAILWAYS.

The section devoted to railways met on the first and second days of the meeting, five papers being read in all. The first paper was on "The Assimilation of Railway Practice as Regards Loads on Bridges up to 200 feet Span," the subject being introduced by Mr. A. Ross. It was pointed out that it was undesirable to carry standardisation